

Elimination Of RoHS Substances In Electronic Products

NEMI RoHS/Pb-Free Summit
October 18-20, 2004

Joe Johnson
Environmental Regulatory Compliance Manager
Microsoft Home & Entertainment Division
(425) 707-4364
joejohn@microsoft.com

Microsoft

Overview

- ◆ RoHS Review
- ◆ Compliance Challenges
- ◆ Common Applications of RoHS Substances in Products
- ◆ RoHS Compliance Strategy: Raising the Bar
- ◆ Summary

What is RoHS?

- ◆ RoHS = EU Directive 2002/95/EC “on the restriction of the use of certain hazardous substances in electrical and electronic equipment”

- ◆ Starting July 2006, RoHS bans:
 - ◆ Lead
 - ◆ Cadmium
 - ◆ Mercury
 - ◆ Hexavalent chromium
 - ◆ Polybrominated biphenyls (PBBs) & polybrominated diphenyl ethers/oxides (PBDEs)

- ◆ Also applies to China RoHS

Original RoHS Annex Exemptions

Applications of lead, mercury, cadmium and hexavalent chromium, which are exempted from the requirements of Article 4(1):

1. Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.
2. Mercury in straight fluorescent lamps for general purposes not exceeding:
 - halophosphate 10 mg
 - triphosphate with normal lifetime 5 mg
 - triphosphate with long lifetime 8 mg.
3. Mercury in straight fluorescent lamps for special purposes.
4. Mercury in other lamps not specifically mentioned in this Annex.
5. Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.
6. Lead as an alloying element in steel containing up to 0,35 % lead by weight, aluminium containing up to 0,4 % lead by weight and as a copper alloy containing up to 4 % lead by weight.
7. — Lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85 % lead),
 - lead in solders for servers, storage and storage array systems (exemption granted until 2010),
 - lead in solders for network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunication,
 - lead in electronic ceramic parts (e.g. piezoelectronic devices).
8. Cadmium plating except for applications banned under Directive 91/338/EEC (1) amending Directive 76/769/EEC (2) relating to restrictions on the marketing and use of certain dangerous substances and preparations.
9. Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators.
- 10. Within the procedure referred to in Article 7(2), the Commission shall evaluate the applications for:**
 - **Deca BDE,**
 - mercury in straight fluorescent lamps for special purposes,
 - **lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signalling, transmission as well as network management for telecommunications (with a view to setting a specific time limit for this exemption), and** — light bulbs,as a matter of priority in order to establish as soon as possible whether these items are to be amended accordingly.

RoHS Compliance Challenges

Key challenge: RoHS substances can potentially occur in any product material

- ❖ Plastics, metals, coatings, components, subassemblies, etc.
- ❖ Specified/sourced by OEM, 1st tier or sub-tier suppliers
- ❖ 100's/1000's of potential compliance risks in a single product

2. Identify RoHS substances in product materials

- ❖ Emphasis: Additions for beneficial material properties

3. Identify & qualify substitutes

- ❖ Functional + RoHS compliance
- ❖ Suppliers are often aware of substitute materials

4. Deploy an expanded risk-based compliance program

RoHS Substances & Typical Test Methods

<u>RoHS Substance</u>	<u>Likely RoHS MCV Limits</u>	<u>Typical Test Methods</u>	<u>Wet Chemical Treatment</u>	<u>Typical Equipment</u>
Lead	1000 ppm (<i>300 ppm for cables-CA Prop 65</i>)	Wet chemical, XRF (X-ray Florescence)	Acid digestion	ICP-AES AAS XRF
Cadmium	100 ppm	Wet chemical, XRF	Acid digestion	ICP-AES AAS XRF
Hexavalent Chromium	1000 ppm	Wet chemical, XRF (elemental Cr)	Grinding, Water extract	ICP-AES AAS XRF (elemental Cr)
Mercury	1000 ppm	Wet chemical, XRF	Evaporation, Adsorption	AAS XRF
PBB/PBDE	1000 ppm	GCMS, FTIR, XRF (elemental Br)	Grinding, Solvent extract	GCMS XRF (elemental Br)

RoHS Substances in Products: Lead

Caveat: LISTS ARE NOT ALL-INCLUSIVE -- just a good place to start

- ◆ Solders (all non-exempted applications)
- ◆ Leads, board finish, internal/external interconnects
- ◆ PVC cables (UV/heat stabilizer)
 - ◆ Substitute: Ca and Sn based stabilizers
- ◆ Pigments, paints

- ◆ Platings, coatings, lubricants
- ◆ Detectors, fuses, photoconductors, glass
- ◆ Metal parts, chassis, washers

RoHS Substances in Products: Cadmium

- ◆ PVC cables
- ◆ Pigments (yellow), paints
- ◆ Metal finishing/plating (low resistance corrosion or wear protection)
 - ◆ Connector/switch/relay contacts
 - ◆ Fasteners
- ◆ Phosphorescent coatings
- ◆ CdS, CdTe detectors/devices/LEDs
- ◆ Recycled plastic materials

RoHS Substances in Products: Mercury

◆ Switches

◆ Lamps, bulbs, lighting

- ◆ Displays, scanners, projectors
- ◆ Exempted applications

◆ Pigments, paints

◆ Polyurethane materials

- ◆ High gloss PU windows

◆ PVC & rubber additives

RoHS Substances in Products: Hexavalent Chromium

- ◆ Metal finishing for corrosion protection (Example: yellow chromate)
 - ◆ Chassis, fasteners
 - ◆ Substitute: Trivalent chromate finishing
- ◆ Pigments, paints
- ◆ Aluminum conversion coatings, alloys
 - ◆ Residual Cr⁺⁶ remain in product?

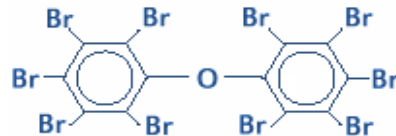
RoHS Substances: Polybrominated Biphenyls & Diphenyl Ethers/Oxides

- ◆ Flame retardants are widely used
 - ❖ Plastics, housings (V0 rated)
 - ❖ Cables
 - ❖ PCBs, connectors, fans
 - ❖ Components (high power/heat)
 - ❖ Paints

- ◆ Non-RoHS substitutes exist
 - ❖ Brominated: Allowable additive/reactive aromatic/aliphatics
 - ❖ Non-brominated: Inorganics (Aluminum, Magnesium, Phosphorus-based)

RoHS Substances: Polybrominated Biphenyls & Diphenyl Ethers/Oxides

- ◆ 3 PBDE Flame retardants of concern:
 - ❖ Penta-bromodiphenyl Ether/Oxide (penta-DBE)
 - Textiles, polyurethane foam
 - Not common in electronics
 - ❖ Octa-bromodiphenyl Ether/Oxide (octa-DBE)
 - Limited use: ABS, injection molded plastics, PCBs
 - Substitutes: Brominated epoxy oligomer, Tetrabromobisphenol A (TBBPA)
 - ❖ Deca-bromodiphenyl Ether/Oxide (deca-DBE)
 - Common: HIPS, PE, ABS, PBT, Epoxy, Nylon plastics
 - Substitute: Decabromodiphenyl ethane
 - Probably RoHS-allowed, but many OEM specs prohibit use



RoHS: Raising The Compliance Bar

◆ Compliance violations are painful!

- ❖ Product quarantine, transport, rework, scrap, lost sales & man-hours, legal action
- ❖ Reflects poorly on brand & image
- ❖ Undercuts ongoing environmental & “due diligence” activities

◆ Pre-RoHS compliance approach

- ❖ Lead and cadmium in cables: #1 risk
 - Approach: Supplier certification of compliance (CoC); Sourcing control; PVC testing
- ❖ Flame retardants: High prevalence of deca-BDE
 - Approach: Supplier CoC & flame retardant disclosure
- ❖ Other restricted substances/ozone depleting chemicals
 - Approach: Supplier CoC

RoHS: Raising The Compliance Bar

Challenge: RoHS substances can potentially occur in any material

- ◆ Identify RoHS substances in product materials
- ◆ Identify & qualify substitutes
- ◆ Deploy an expanded risk-based compliance program
 - ❖ Putting requirements in specifications/contracts: It's necessary, but not adequate to reduce risks
 - ❖ Elements of a compliance program strategy
 - Product-specific risk assessment: Identification of high risk materials & key sourcing centers
 - Educate sourcing centers ('checklist')
 - Introduce supplier SDoCs & material disclosures
 - Limited risk-based testing using approved methods/labs
 - Compliance program audits

RoHS: Raising The Compliance Bar

Goal: Reliable, Documented Sourcing of Compliant Materials

◆ Assess product compliance risks

- ◆ High compliance risk = Known application of regulatory restricted substance in product materials
 - Compliance approach: Informed sourcing; Supplier declaration of conformity (SDoC, per ISO/IEC 17050)
 - SDoCs + disclosure + Limited testing
 - Examples: Lead, cadmium in PVC; Lead in solders/PCBs; Flame retardants

- ◆ Low compliance risk = No likely applications in product materials
 - Approach: SDoCs
 - Examples: RoHS & non-RoHS substances with no expected applications in specific product materials

RoHS: Raising The Compliance Bar

Using Portable XRF to Screen for RoHS Substances In Product Development Stage

◆ Advantages

- ❖ Portable, safe, reliable operation, easy to use, low maintenance, no hazardous waste generation
- ❖ Provides real-time analytical information for many elements in diverse matrices
- ❖ Excellent screening tool for detecting elemental RoHS substances with 1000 PPM MCVs
- ❖ Potential RoHS issues resolved pre-production

◆ Challenges

- ❖ Large spot size (~1cm); Subject to multiple-element and matrix interferences
- ❖ Low sensitivity for cadmium (Inconsistent < 100 PPM)
- ❖ May not provide unequivocal RoHS compliance determination
- ❖ Must be used in conjunction with other analytical methods

In Summary

- ◆ RoHS Requires New Understanding of Product Materials & Compliance Risks
- ◆ RoHS Will Drive Expanded Compliance Requirements Through Supply Chain
- ◆ Compliance Tools: Education/SDoCs/Testing/Auditing
 - ◆ Screening Products During Development w/Portable XRF Can Be Useful
- ◆ NEMI 2004 Roadmap
 - ◆ Environmentally Conscious Electronics Chapter